OFFPIPE Assistant™

User Manual

Version: 2.0.2

INDEX

1 FUNCTION

OFFPIPE Assistant™ is a set of computer aided design software for offshore pipeline S-Lay. This software is used to provide optimized configuration parameters for S-Lay barge, with little cost of calculating time. Efficiency and quality of offshore pipelay design can be improved by using OFFPIPE Assistant™.

OFFPIPE Assistant™ has several feature functions as following:

1. Precise laybarge and stinger modeling. It is easy for users using OFFPIPE Assistant™ to construct precise model of laybarge and stinger, which can be saved as model file and read by the software directly in the future. Users can get roller coordinates corresponding to the bending radius of pipeline specified by users rapidly. This function makes it possible to build a laybarge model database of a company, which will be called directly in analysis. This type of model building improves the efficiency, precision and convenience of laybarge and stinger model construction compared with that of OFFPIPE.

2. Finite element analysis for normal pipe laying. Just like OFFPIPE, it is a basic function of OFFPIPE Assistant™ to conduct static finite element analysis for normal pipe laying. According to engineering parameters input by users, the software can provide FEA results rapidly. Due to focus of software, OFFPIPE Assistant™ does not provide modules of initial laying, abandon/recovery and dynamic analysis.

3. Optimized laying parameters selection. This function allows users to obtain optimized laybarge configuration with minimum total stress within the specified pipeline bending radius and tension scope, according to FEA results. Although the analysis results of OFFPIPE Assistant™ and OFFPIPE are almost the same, users are allowed to select a calculating core within OFFPIPE Assistant™ FEA core and OFFPIPE FEA core. If OFFPIPE core is chosen, it should be noted that the calculation time will increase because of the time of operating OFFPIPE.

By above functions of OFFPIPE Assistant™, users can get best laybarge configuration for certain pipe laying project, which is an important reference for later design procedures.

2 INSTALLATION

To start to use OFFPIPE Assistant™, please:

1. Insert the installation CD into the CD-ROM drive, or unzip the installation pack file.

2. Copy “OFFPIPE Assistant” folder in root directory of installation CD or installation pack file to hard disk of your PC.

3. Insert the attached hard lock into one of USB port in your PC.

4. Double click “OFFPIPE Assistant.exe” icon in the folder to start the software.

OFFPIPE Assistant™ runs on PC with Windows XP or Windows 7.

3 HOW TO USE

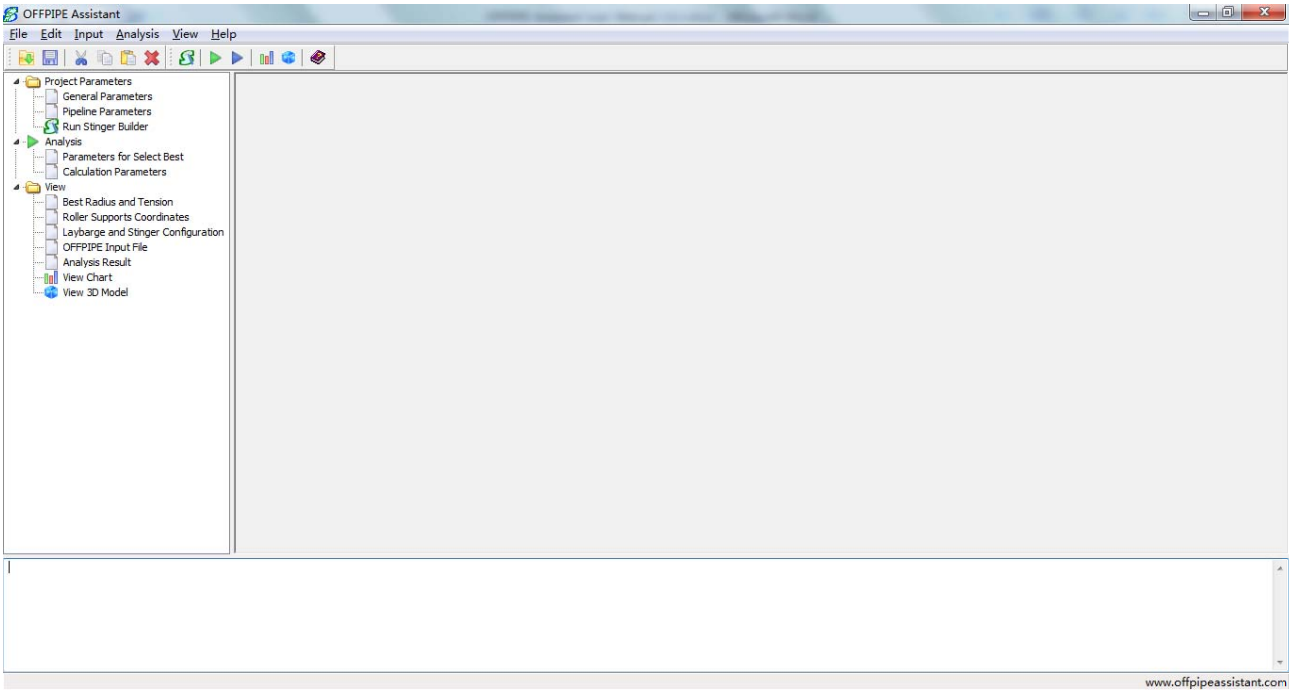


Fig. 3.1 Main interface of OFFPIPE Assistant™

Figure 3.1 shows the main interface of OFFPIPE Assistant™, which includes 4 main parts:

1. Main menu and tool buttons are in the top of window, which are used to run important functions of the software.

2. A tree view is in the left of interface, users can go to any part of the software by clicking the corresponding item in the tree view.

3. In the right, there is the operation window, which is used to edit model, run analysis and view the results.

4. In the bottom is the description window, it shows some descriptions and guides for user.

Brief procedure of running OFFPIPE Assistant™ is shown as following:

1. Edit or load project parameters.

(1) Click “Project Parameters” in the tree view, and click the buttons to load / save your project parameters, or call Stinger Builder™ to build your laybarge & stinger models. If there is no project file to load, then go to the next step to edit your project parameters.

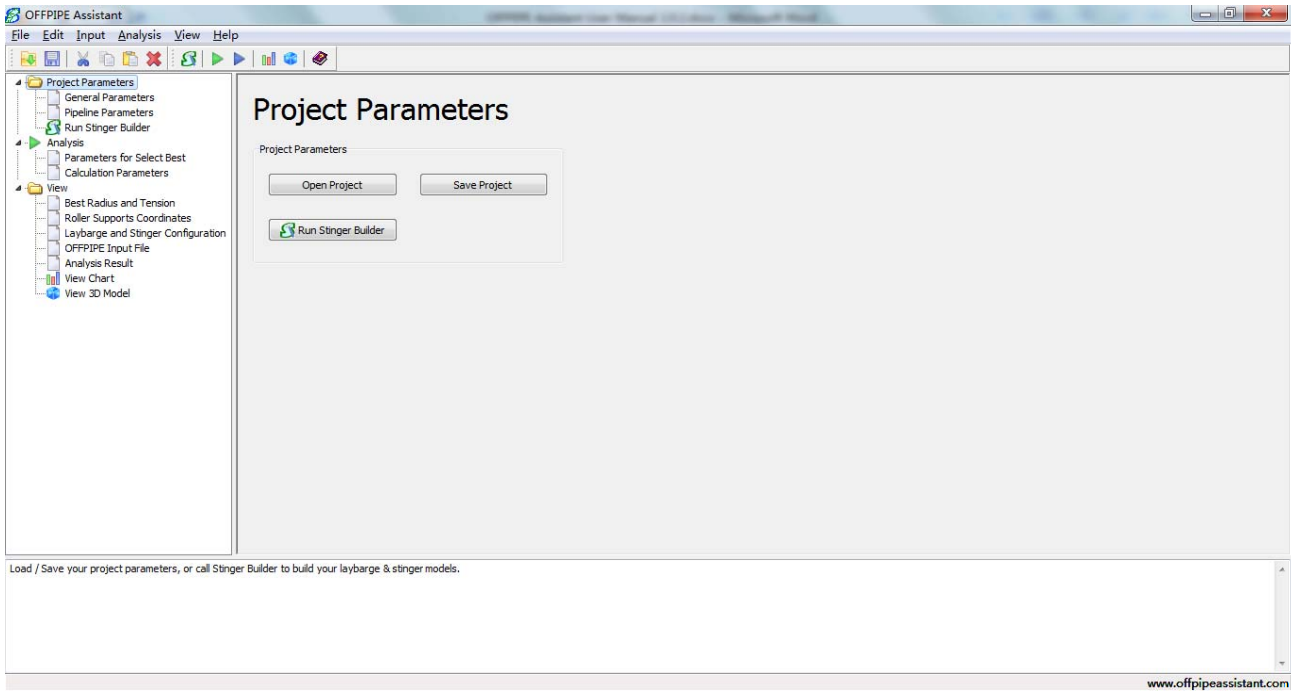


Fig. 3.2 Load or save project parameters

(2) Click “General Parameters” in the tree view, and input general parameters of the project in operation window:

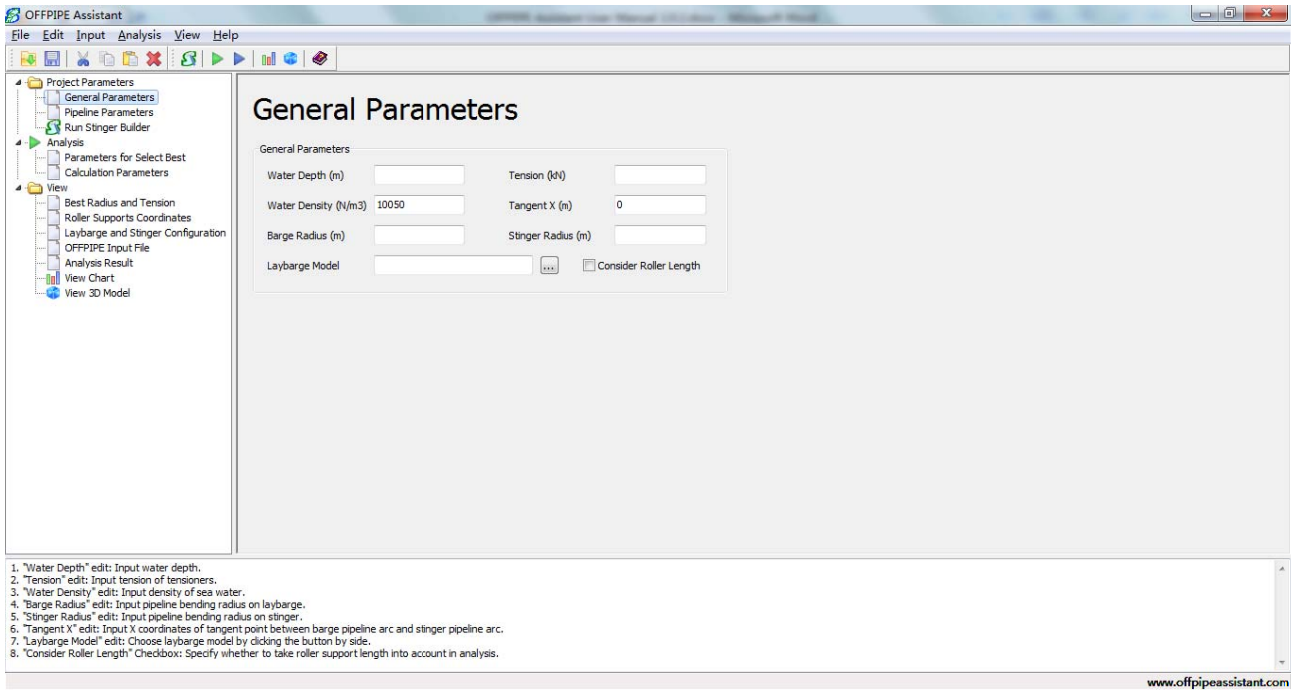


Fig. 3.3 Input general parameters

In which:

“Water Depth” edit: Input water depth.

“Tension” edit: Input tension of tensioners.

"Water Density" edit: Input density of sea water.

"Tangent X" edit: Input X coordinates of tangent point between barge pipeline arc and stinger pipeline arc.

"Barge Radius" edit: Input pipeline bending radius on laybarge.

"Stinger Radius" edit: Input pipeline bending radius on stinger.

"Laybarge Model" edit: Choose laybarge model by clicking the button by side.

"Consider Roller Length" Checkbox: Specify whether to take roller support length into account in analysis.

(3) Click "Pipeline Parameters" in the tree view, and input pipeline parameters of the project in operation window:

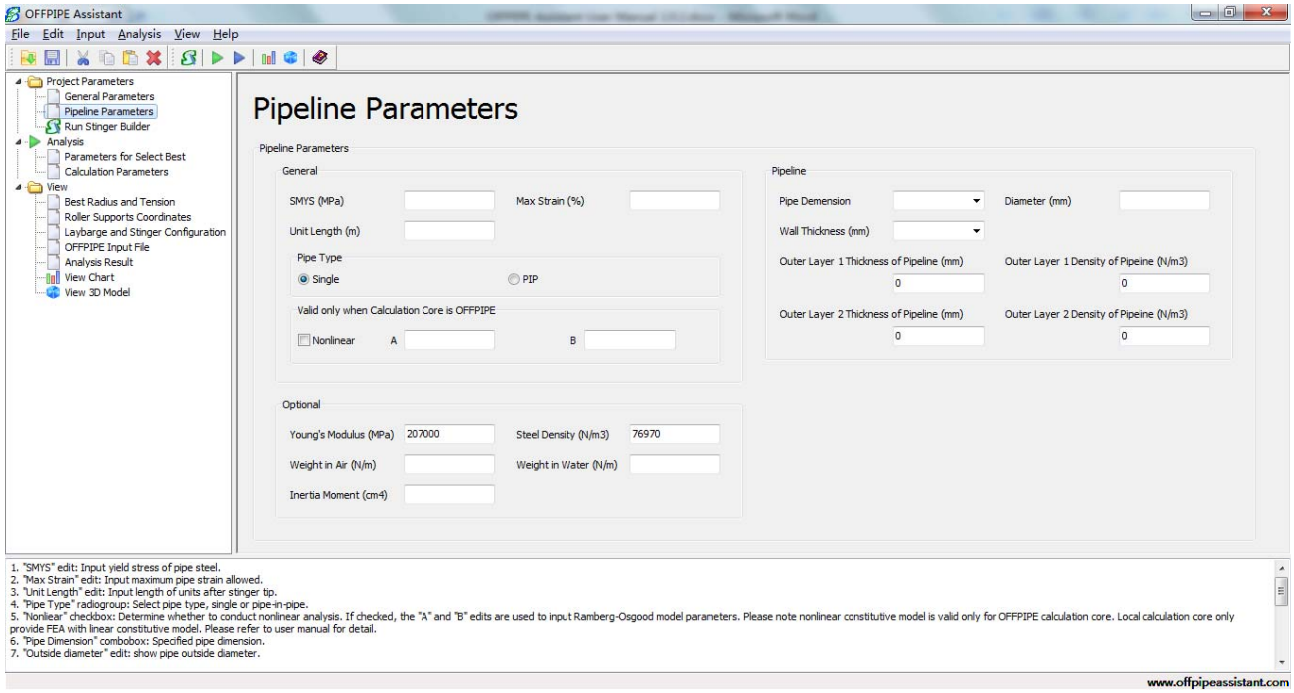


Fig. 3.4 Input pipeline parameters

In which:

In "General" Groupbox:

"SMYS" edit: Input yield stress of pipe steel.

"Max Strain" edit: Input maximum pipe strain allowed.

"Unit Length" edit: Input length of units after stinger tip.

"Pipe Type" radiogroup: Select pipe type, single or pipe-in-pipe.

"Nonliear" checkbox: Determine whether to conduct nonlinear analysis. If checked, the "A" and "B" edits are used to input Ramberg-Osgood model parameters. Please note nonlinear constitutive model is valid only for OFFPIPE calculation core. Local calculation core only provide FEA with linear constitutive model.

Ramberg-Osgood equation in moment-curvature form is:

$$\frac{K}{K_y} = \frac{M}{M_y} + A\left(\frac{M}{M_y}\right)^B \tag{4.1}$$

in which

$$K_y = \frac{2 \times SMYS}{ED} \tag{4.2}$$

$$M_y = \frac{2 \times SMYS \times I}{D} \tag{4.3}$$

$$I = \frac{\pi(D^4 - (D-2t)^4)}{64} \tag{4.4}$$

where

K Curvature;

K_y Nominal yield curvature;

M Moment;

M_y Nominal yield moment;

A Ramberg-Osgood parameter in moment-curvature form;

B Ramberg-Osgood parameter in moment-curvature form;

I The area moment of inertia;

D Outside diameter of the pipeline;

t Wall thickness of the pipeline.

In “Pipeline” Groupbox:

“Pipe Dimension” combobox: Specified pipe dimension.

“Outside diameter” edit: show pipe outside diameter.

“Wall Thickness” combobox: Input wall thickness of pipe.

“Outer Layer 1 Thickness of Pipeline” edit: Input thickness of pipe coat 1.

“Outer Layer 1 Density of Pipeline” edit: Input density of pipe coat 1.

“Outer Layer 2 Thickness of Pipeline” edit: Input thickness of pipe coat 2.

“Outer Layer 2 Density of Pipeline” edit: Input density of pipe coat 2.

In “Optional” Groupbox, parameters are optional, if not specified or specified as zero, then a default value will be specified by the software.

“Young”s Modulus of Pipe Steel” edit: Input Young”s Modulus of pipe steel. Default value is 207000MPa

“Steel Density” edit: Input density of pipe steel. Default value is 76970N/m^3.

“Weight in Air” edit: Input pipeline weight per meter in air. If not specified or specified as zero, this value will be calculated automatically by the software.

“Weight in Water” edit: Input pipeline weight per meter in water. If not specified or

specified as zero, this value will be calculated automatically by the software.

"Inertia Moment" edit: Input inertia moment of pipeline cross section. If not specified or specified as zero, this value will be calculated automatically by the software.

(4) Click "Run Stinger Builder" in the tree view, and click the buttons to run Stinger Builder™ to build your laybarge & stinger models.

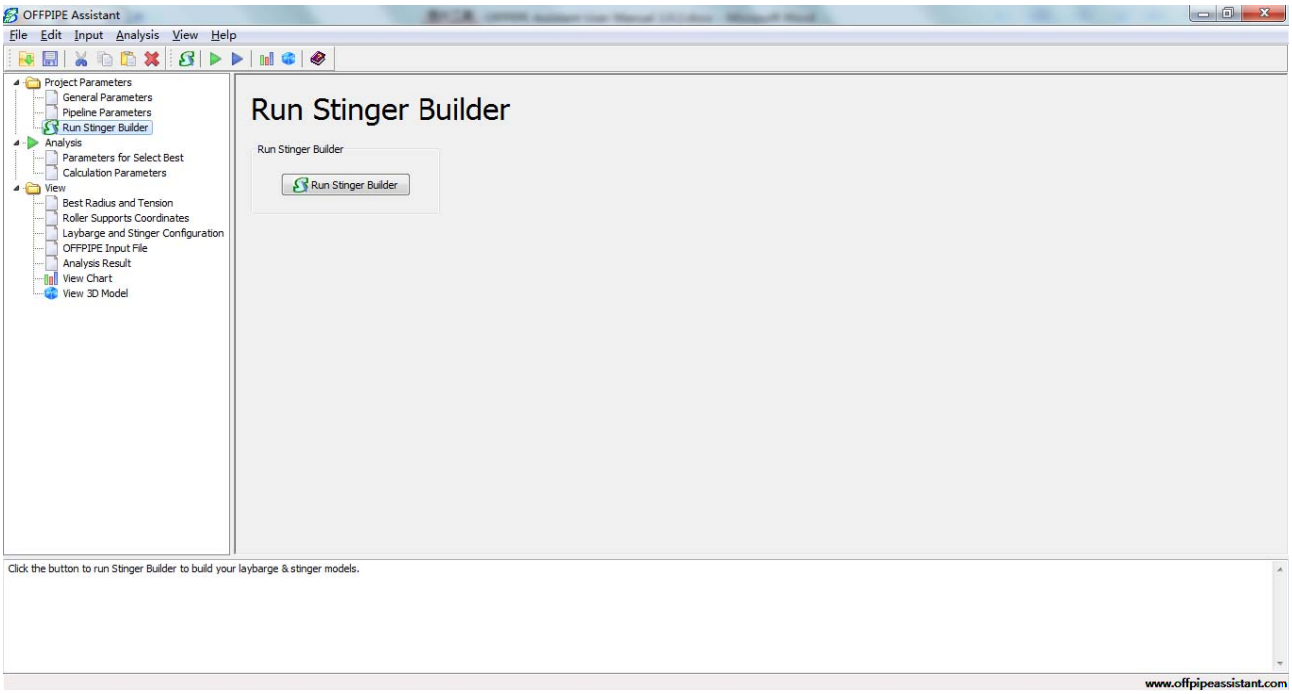


Fig. 3.5 Call Stinger Builder™

2. Input analysis parameters and run the analysis to get roller supports coordinates.

(1) Click "Analysis" in the tree view, and click the buttons to run the analysis, if user want to edit some parameters for analysis, then just go to next step.

"Single Analysis" button: Conduct static normal pipe laying FEA for single case.

"Select Best" button: Conduct calculation of choosing best laying parameters with minimum total stress.

Time wasted and iteration times are shown in "Time" and "Cycle Number" edits.

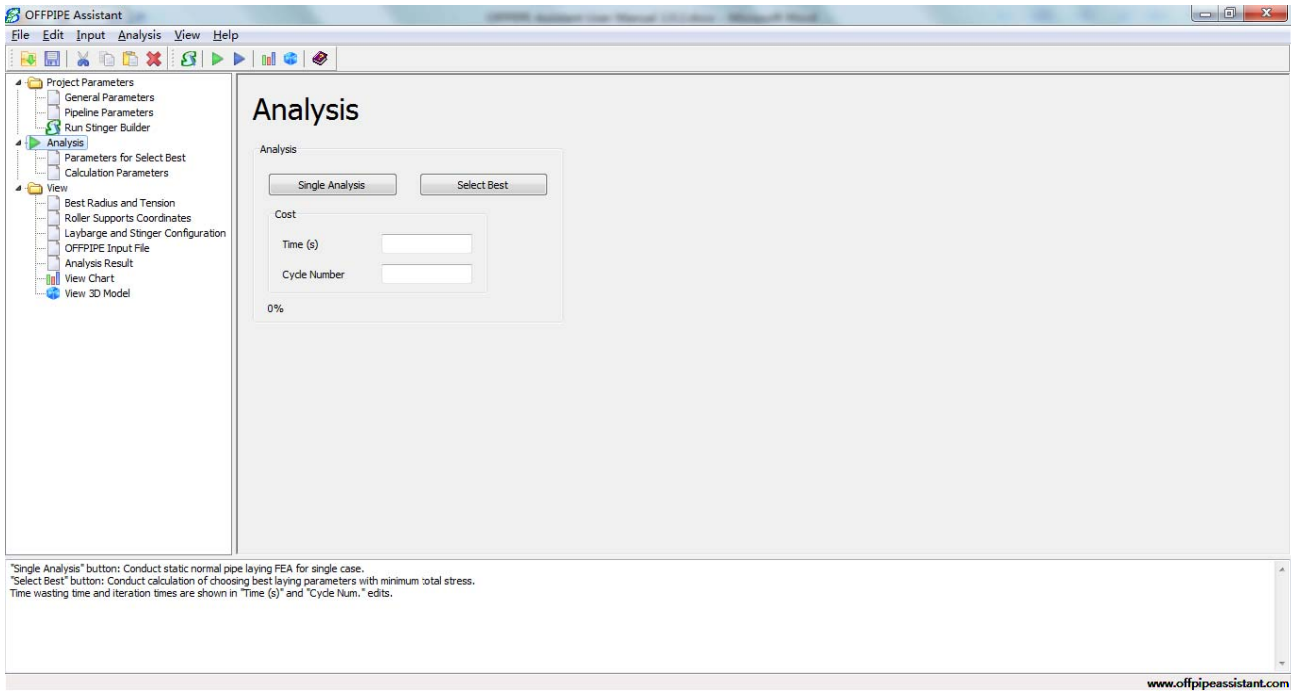


Fig. 3.6 Run analysis

(2) Click “Parameters for Select Best” in the tree view, and input parameters for choosing best laying parameters.

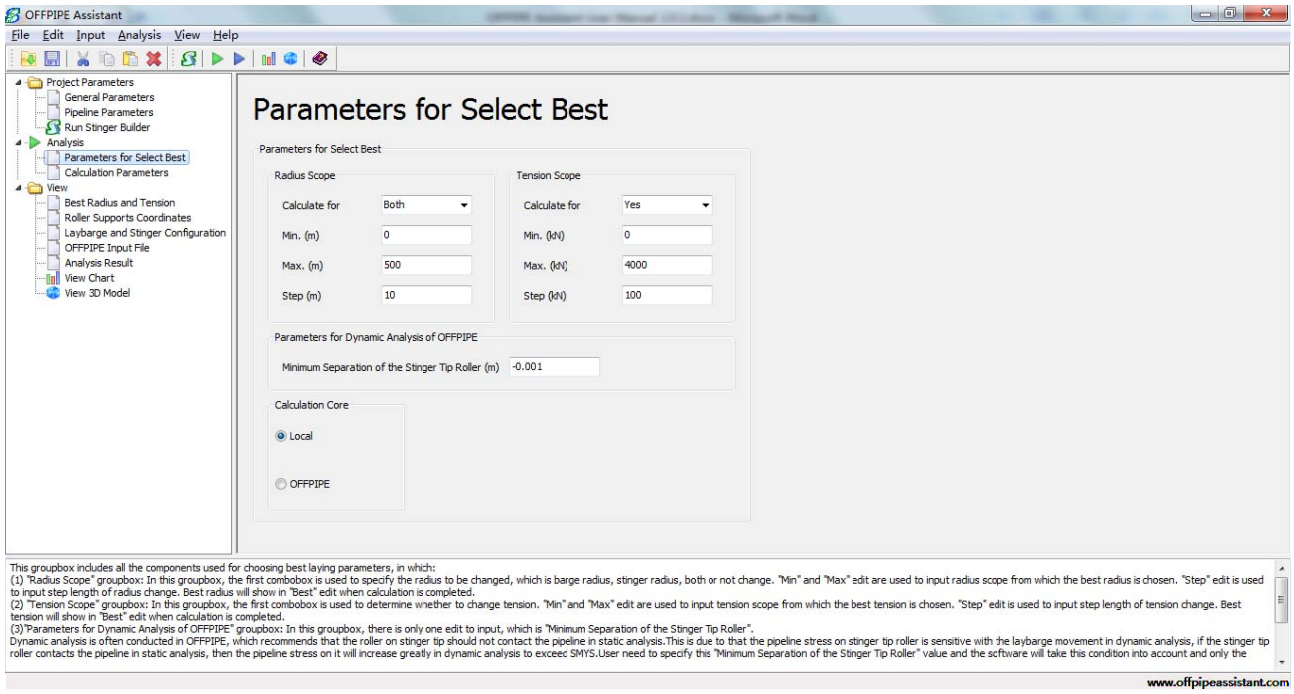


Fig. 3.7 Input parameters for select best

In which:

“Radius Scope” groupbox: In this groupbox, the first combobox is used to specify the radius to be changed, which is barge radius, stinger radius, both or not change. “Min.” and

“Max.” edit are used to input radius scope from which the best radius is chosen. “Step” edit is used to input step length of radius change. Best radius will show in “Best” edit in “View” part when calculation is completed.

“Tension Scope” groupbox: In this groupbox, the first combobox is used to determine whether to change tension. “Min.” and “Max.” edit are used to input tension scope from which the best tension is chosen. “Step” edit is used to input step length of tension change. Best tension will show in “Best” edit in “View” part when calculation is completed.

“Parameters for Dynamic Analysis of OFFPIPE” groupbox: In this groupbox, there is only one edit to input, which is “Minimum Separation of the Stinger Tip Roller”. Dynamic analysis is often conducted in OFFPIPE, which recommends that the roller on stinger tip should not contact the pipeline in static analysis. This is due to that the pipeline stress on stinger tip roller is sensitive with the laybarge movement in dynamic analysis, if the stinger tip roller contacts the pipeline in static analysis, then the pipeline stress on it will increase greatly in dynamic analysis to exceed SMYS. User need to specify this “Minimum Separation of the Stinger Tip Roller” value and the software will take this condition into account and only the results in which the separation of stinger tip roller is greater that this value will be take into the comparison for select best tension and pipeline bending radius. Then user can input the output result of OFFPIPE Assistant™ into OFFPIPE to run dynamic analysis for checking whether the result is acceptable.

“Calculation Core” radiogroup: Although the analysis results of OFFPIPE Assistant™ and OFFPIPE are almost the same, users are allowed to select a calculating core within OFFPIPE Assistant™ FEA core and OFFPIPE FEA core. Here choose calculation core from local and OFFPIPE. If OFFPIPE core is specified, OFFPIPE Assistant™ will establish a new file named “CALC.dat” in “DATA” folder and a new file named “CALC.out” in “OUTPUT” folder in OFFPIPE directory, and then conducts analysis with these two files. Users can check the analysis result of OFFPIPE by view the “CALC.out” file. If OFFPIPE core is specified, the path of OFFPIPE.bat file has to be specified by clicking the button beside “OFFPIPE.BAT Path” edit, and the time consuming of OFFPIPE conducting analysis for one time has to be estimated in “Interval” edit. It should be noted that the calculation time will increase compared with local core because of the time wasting of operating OFFPIPE. If OFFPIPE FEA core is specified, before analysis, please start OFFPIPE and enter main operating interface by press enter button, then press Alt+Enter to transfer OFFPIPE from full screen mode to window mode.

(3) Click “Calculation Parameters” in the tree view, and input calculation parameters in operation window. For the detail of calculation parameters, please refer to Stinger Builder™

user manual.

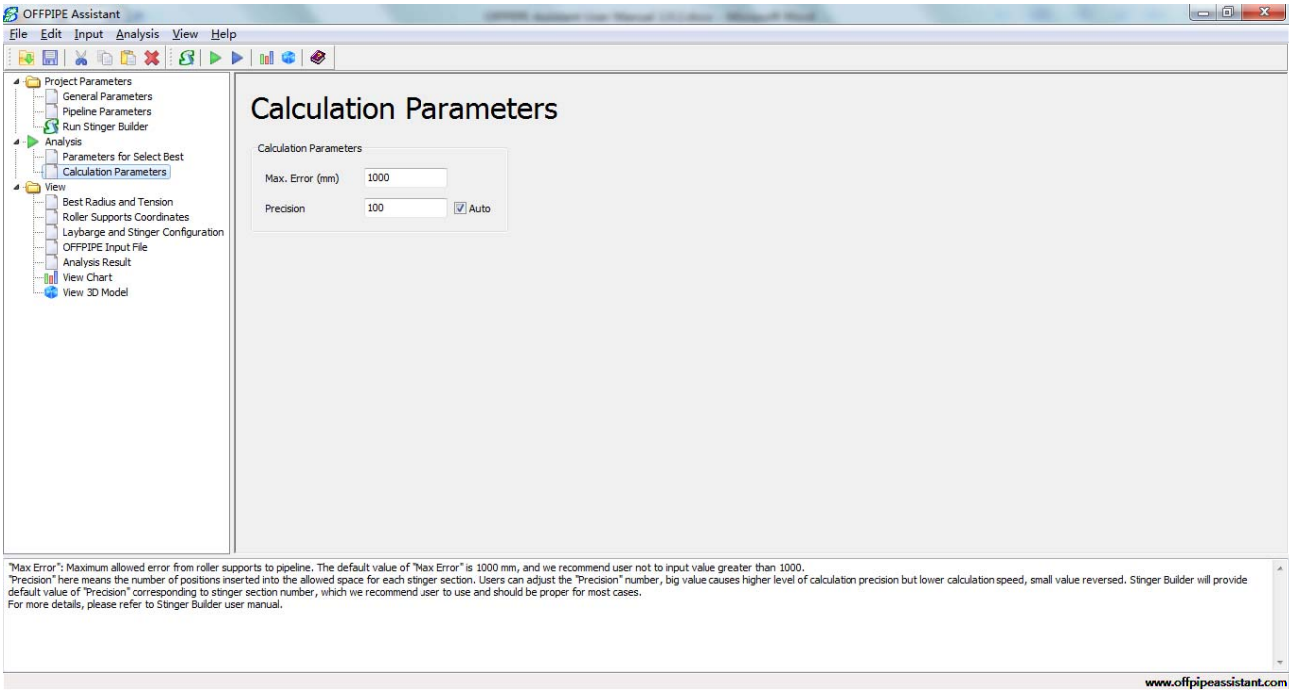


Fig. 3.8 Input calculation parameters

When the checkbox “Auto” below checked, then default value of “Precision” will be filled into the precision blank automatically. If user wants to specify “Precision” value manually, he just need to uncheck the “Auto” checkbox.

3. View the result

(1) Click “View” in the tree view, and select what you want to view, or just click following nodes in the tree view.

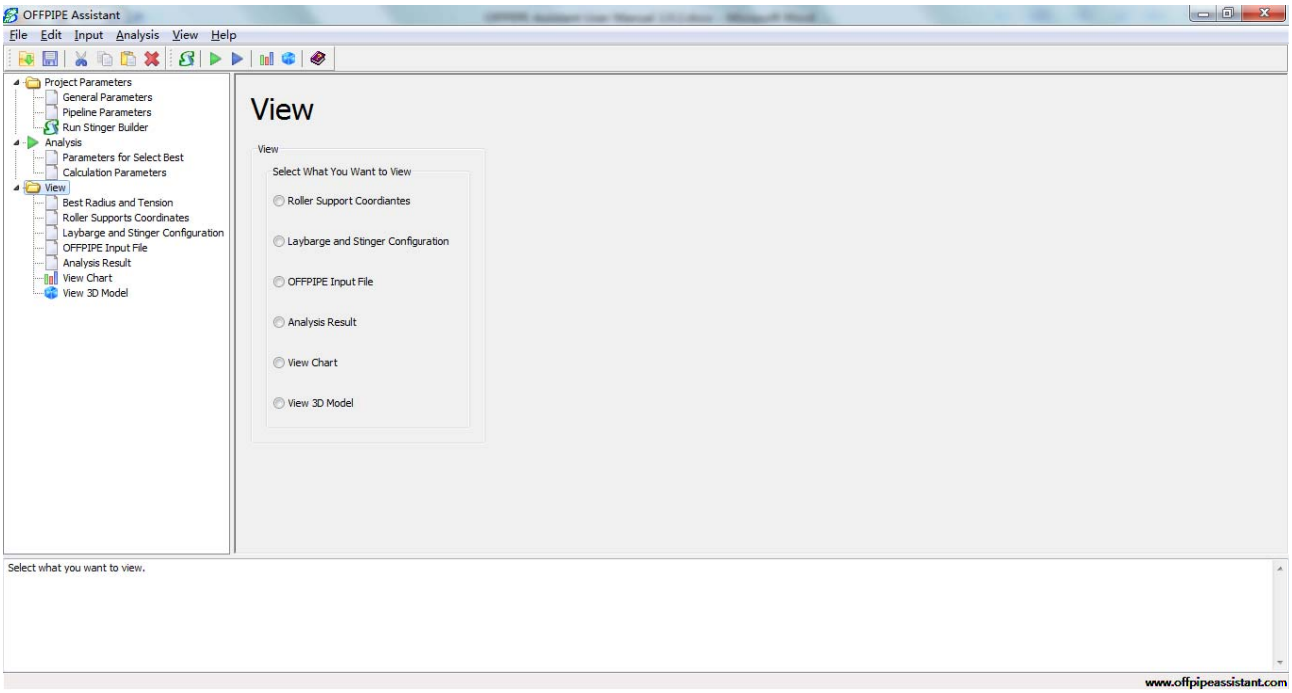


Fig. 3.9 Select what you want to view

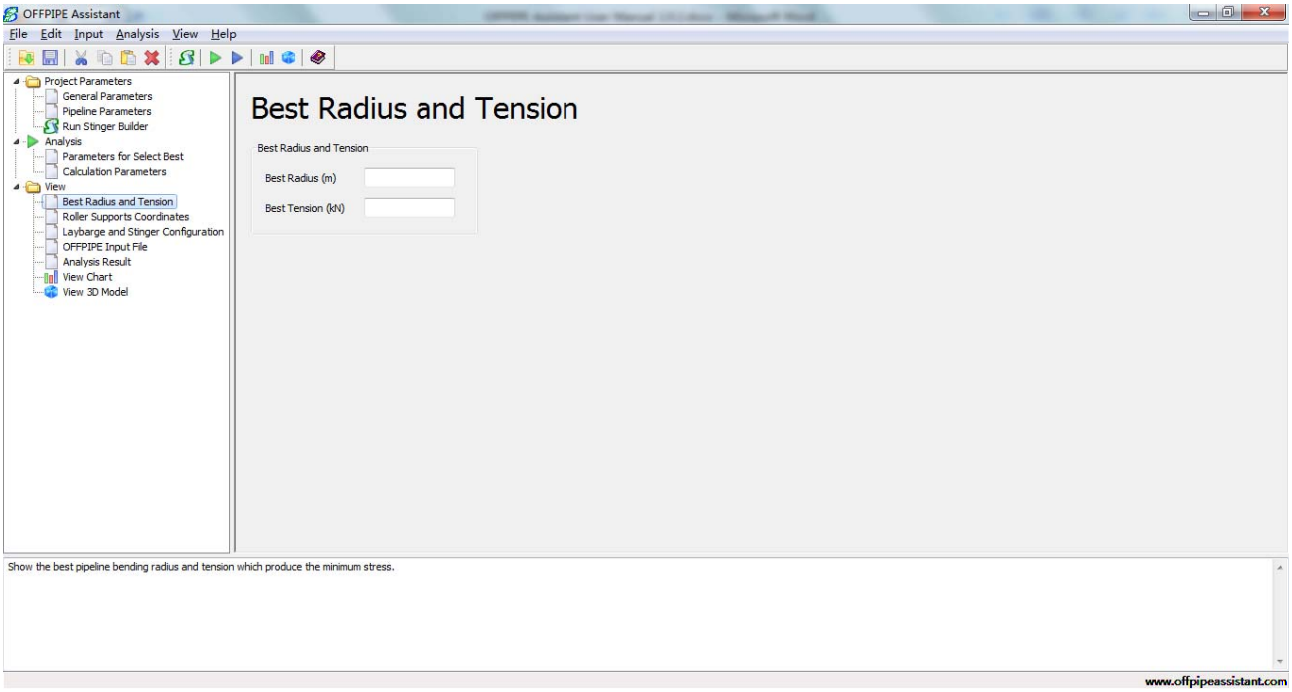


Fig. 3.10 View Best Radius and Tension

(2) Click “Best Radius and Tension” in the tree view to view best radius and tension which produce the minimum total stress if “Select Best” is conducted.

(3) Click “Roller Supports Coordinates” in the tree view to view support roller coordinates.

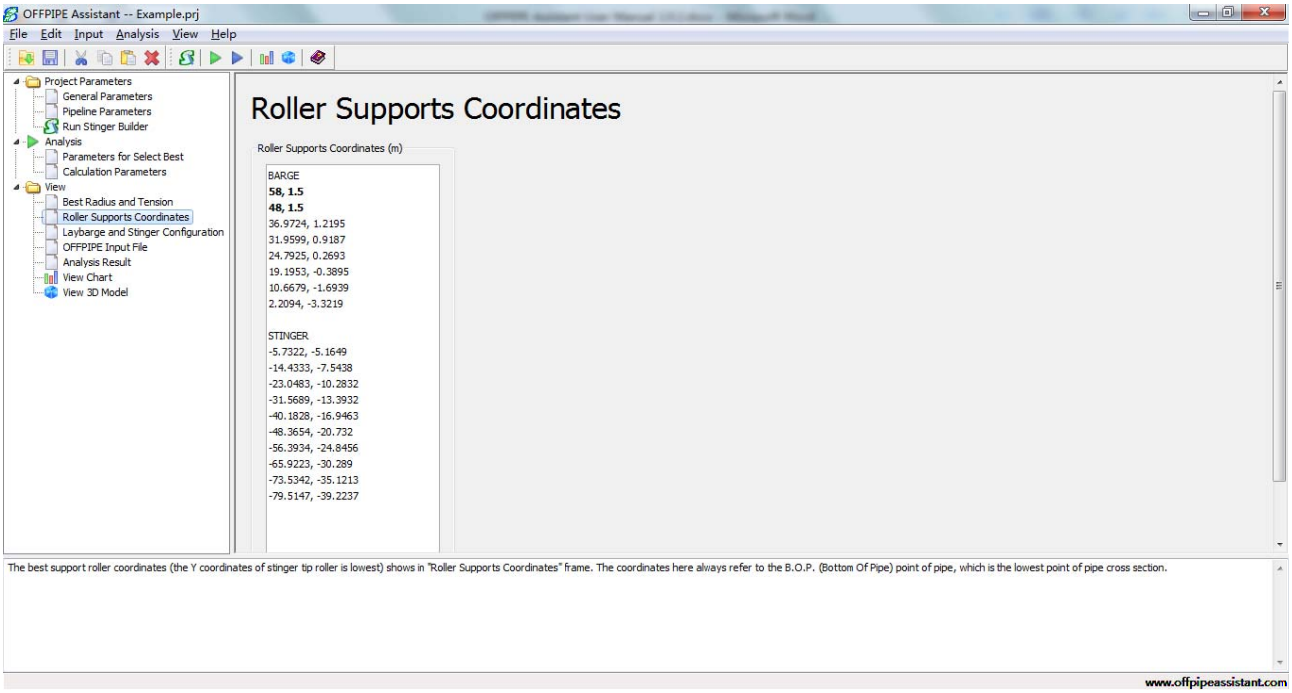


Fig. 3.11 View roller supports coordinates

If the analysis has been run to generate best support roller coordinates (the Y coordinates of stinger tip roller is lowest). The result will show in “Roller Supports Coordinates” frame. The coordinates here always refer to the B.O.P. (Bottom Of Pipe) point of pipe, which is the lowest point of pipe cross section.

(4) Click “Laybarge and Stinger Configuration” to view it.

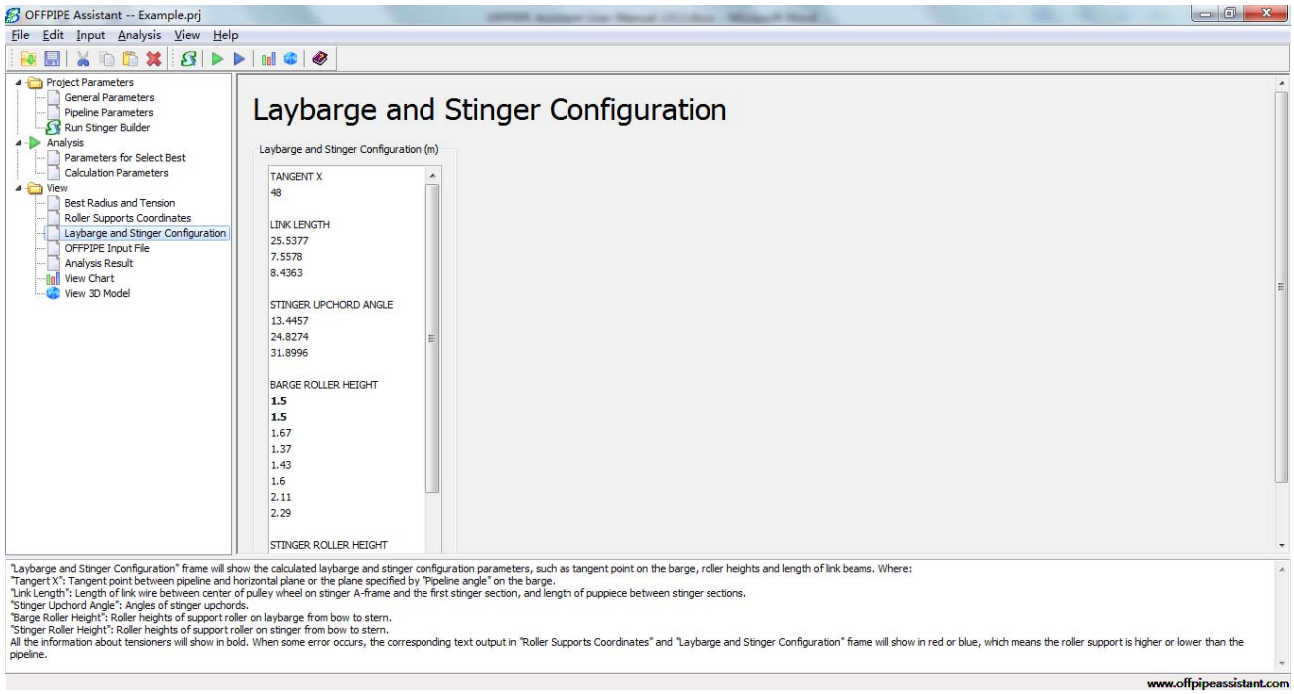


Fig. 3.12 View laybarge and stinger configuration

“Laybarge and Stinger Configuration” frame will show the calculated laybarge and stinger configuration parameters, such as tangent point on the barge, roller heights and length of link beams. Where:

“Tangert X”: Tangent point between pipeline and horizontal plane or the plane specified by “Pipeline angle” on the barge, unit is meter.

“Link Length”: Length of link wire between center of pulley wheel on stinger A-frame and the first stinger section, and length of puppiece between stinger sections, unit is meter.

“Stinger Upchord Angle”: Angles of stinger upchords, unit is degree.

“Barge Roller Height”: Roller heights of support roller on laybarge from bow to stern, unit is meter.

“Stinger Roller Height”: Roller heights of support roller on stinger from bow to stern, unit is meter.

All the information about tensioners will show in bold. When some error occurs, the corresponding text output in “Roller Supports Coordinates” and “Laybarge and Stinger Configuration” frame will show in red or blue, which means the roller support is higher or

lower than the pipeline, and “Laybarge and Stinger Configuration” frame will show the separation between roller supports and pipeline.

Both “Roller Supports Coordinates” and “Laybarge and Stinger Configuration” frame will show fault messages if the increased error exceeds the “Max Error” and the program can not generate a laybarge and stinger configuration by the given pipeline bending radius within the max allowed error.

(5) Click “OFFPIPE Input File” in the tree view to transform the present engineering parameters to OFFPIPE input file to be calculated by OFFPIPE. Click the button to save the OFFPIPE input file.

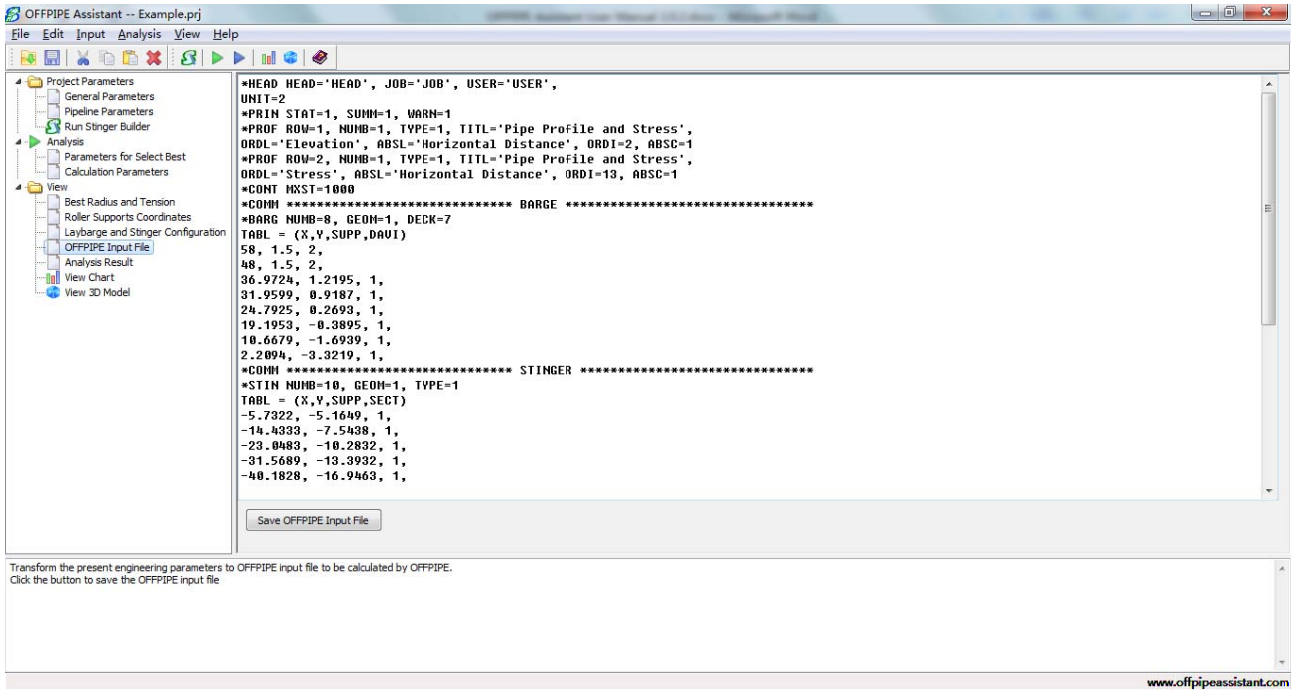
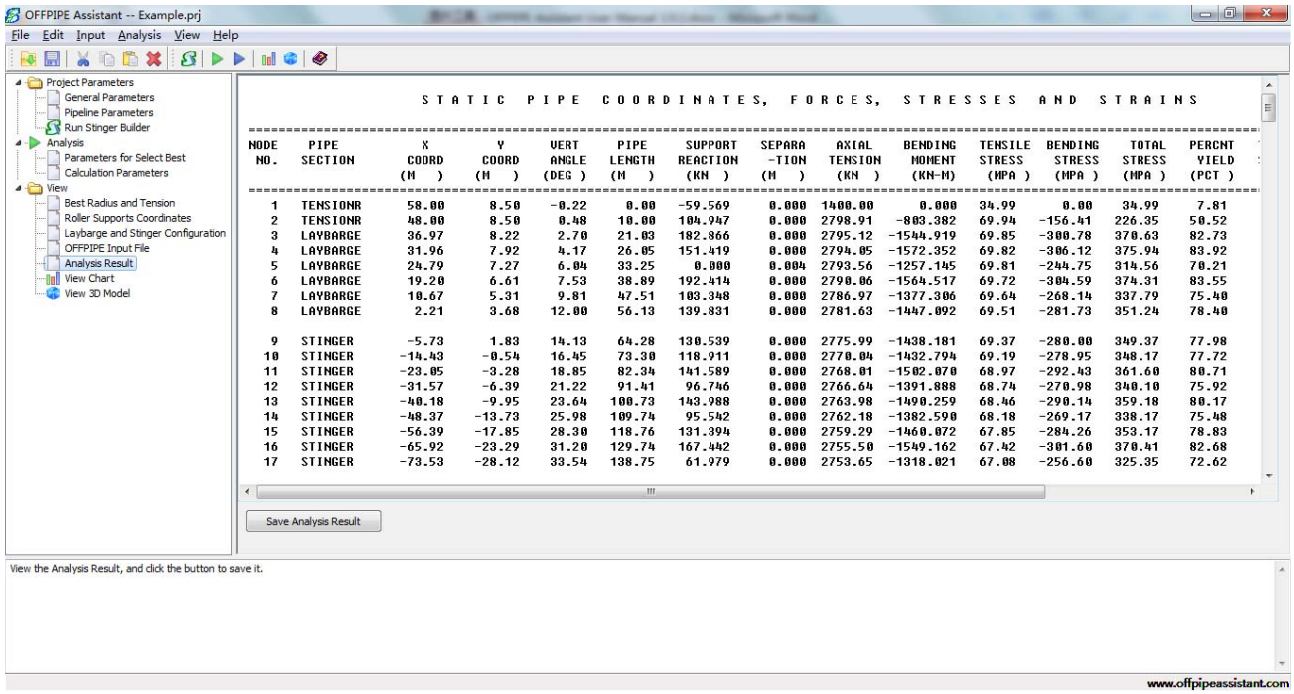


Fig. 3.13 View OFFPIPE input file



STATIC PIPE COORDINATES, FORCES, STRESSES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	VERT ANGLE (DEG)	PIPE LENGTH (M)	SUPPORT REACTION (KN)	SEPARA -TION (M)	AXIAL TENSION (KN)	BENDING MOMENT (KN-M)	TENSILE STRESS (MPA)	BENDING STRESS (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	58.00	8.50	-0.22	0.00	-59.569	0.000	1400.00	0.000	34.99	0.00	34.99	7.81
2	TENSIONR	48.00	8.50	0.48	10.00	104.947	0.000	2798.91	-803.382	69.94	-156.41	226.35	50.52
3	LAYBARGE	36.97	8.22	2.70	21.03	182.866	0.000	2795.12	-1544.919	69.85	-300.78	370.63	82.73
4	LAYBARGE	31.96	7.92	4.17	26.05	151.419	0.000	2794.05	-1572.352	69.82	-306.12	375.94	83.92
5	LAYBARGE	24.79	7.27	6.04	33.25	0.000	0.004	2793.56	-1257.145	69.81	-244.75	314.56	70.21
6	LAYBARGE	19.20	6.61	7.53	38.89	192.414	0.000	2790.06	-1564.517	69.72	-304.59	374.31	83.55
7	LAYBARGE	10.67	5.31	9.81	47.51	103.348	0.000	2786.97	-1377.306	69.64	-268.14	337.79	75.40
8	LAYBARGE	2.21	3.68	12.00	56.13	139.831	0.000	2781.63	-1447.092	69.51	-281.73	351.24	78.40
9	STINGER	-5.73	1.83	14.13	64.28	130.539	0.000	2775.99	-1438.181	69.37	-280.00	349.37	77.98
10	STINGER	-14.43	-0.54	16.45	73.30	118.911	0.000	2770.04	-1432.794	69.19	-278.95	348.17	77.72
11	STINGER	-23.05	-3.28	18.85	82.34	141.589	0.000	2768.01	-1502.070	68.97	-292.43	361.60	80.71
12	STINGER	-31.57	-6.39	21.22	91.41	96.746	0.000	2766.64	-1391.888	68.74	-270.98	340.10	75.92
13	STINGER	-40.18	-9.95	23.64	100.73	143.988	0.000	2763.98	-1490.259	68.46	-290.14	359.18	80.17
14	STINGER	-48.37	-13.73	25.98	109.74	95.542	0.000	2762.18	-1382.590	68.18	-269.17	338.17	75.48
15	STINGER	-56.39	-17.85	28.30	118.76	131.394	0.000	2759.29	-1460.072	67.85	-284.26	353.17	78.83
16	STINGER	-65.92	-23.29	31.20	129.74	167.442	0.000	2755.50	-1549.162	67.42	-301.60	370.41	82.68
17	STINGER	-73.53	-28.12	33.54	138.75	61.979	0.000	2753.65	-1318.021	67.08	-256.60	325.35	72.62

Fig. 3.14 View analysis result

(6) Click “Analysis Result” in the tree view to view the finite element analysis result, and click the button to save it.

(7) Click “View Chart” in the tree view to view analysis result by charts.

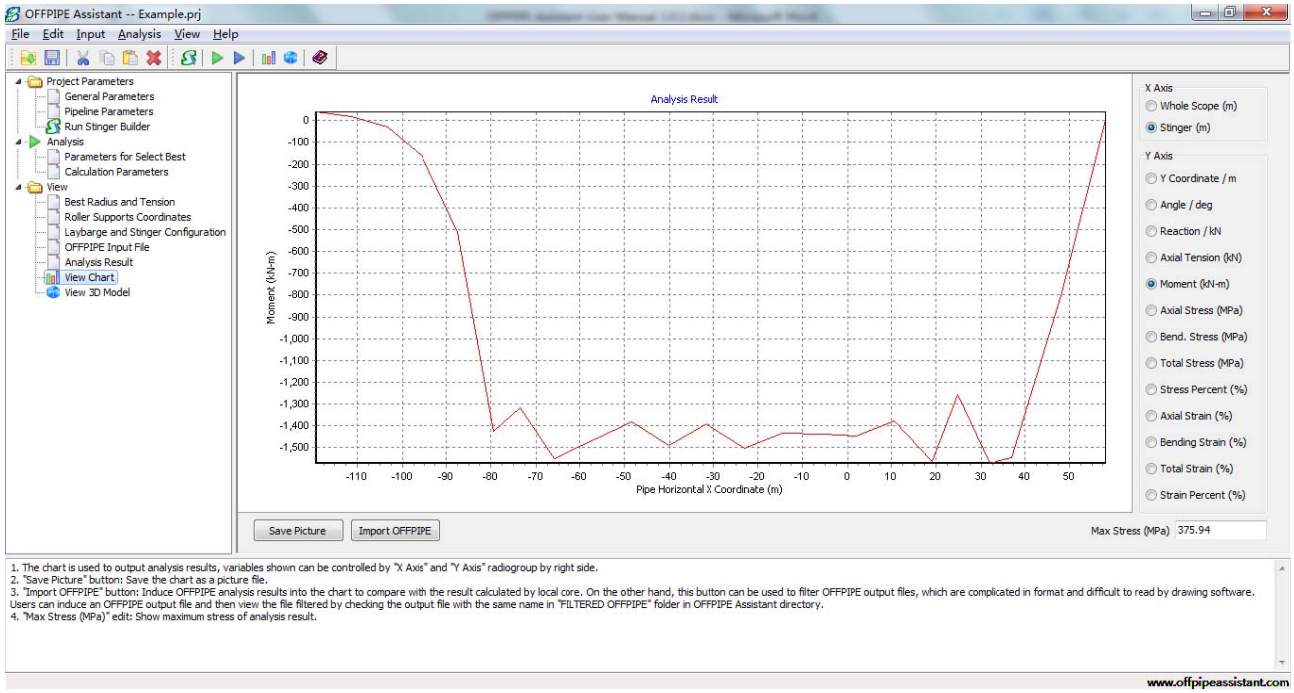


Fig. 3.15 View chart

In which:

The chart in the middle of main interface is used to output analysis results, variables shown can be controlled by “X Axis” and “Y Axis” radiogroup by right side.

"Save Picture" button: Save the chart as a picture file.

"Import OFFPIPE" button: Induce OFFPIPE analysis results into the chart to compare with the result calculated by local core. On the other hand, this button can be used to filter OFFPIPE output files, which are complicated in format and difficult to read by drawing software. Users can induce an OFFPIPE output file and then view the file filtered by checking the output file with the same name in "FILTERED OFFPIPE" folder in OFFPIPE Assistant directory.

"Max Stress (MPa)" edit: Show maximum stress of analysis result.

(8) Click "View 3D Model" to view 3D model of calculated profile of pipeline and stinger.

In the 3D model window, "Roller State" checkbox is used to control whether to show roller support errors. When the roller support is higher than pipeline, it shows red, when lower, shows blue, when the pipeline B.O.P. is within the roller support adjustable range, the support shows green.

"Stress State" checkbox is used to control whether to show pipeline stress state. The pipeline shows red at the node in which total stress > SMYS. Other color means total stress < SMYS at this node. Here is stress of Red > Yellow > Green > Sky Blue > Deep Blue.

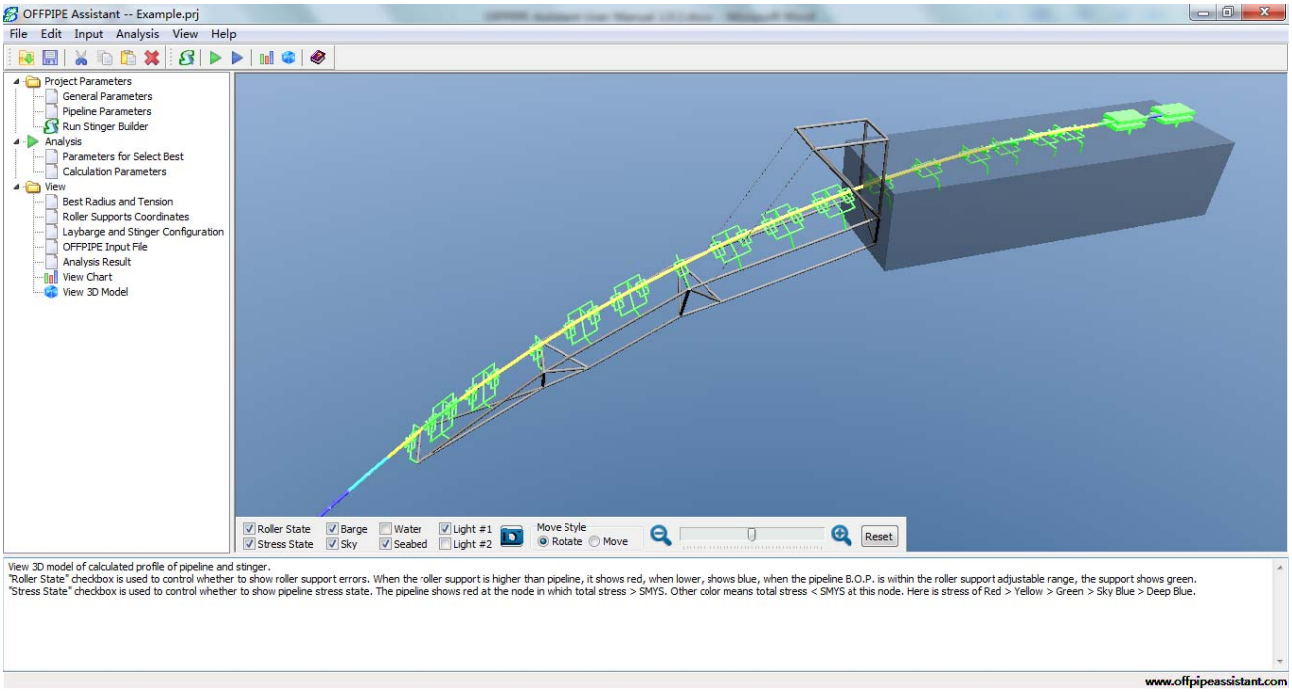


Fig. 3.16 View 3D Model

Some functions in the tree view can be directly conducted from main menu and tool buttons. Just try it by yourself.

4 FAULT MESSAGES & NOTES

Some fault messages may be encountered by users and notes are listed below:

1. A message window as Fig. 5.1 shows.

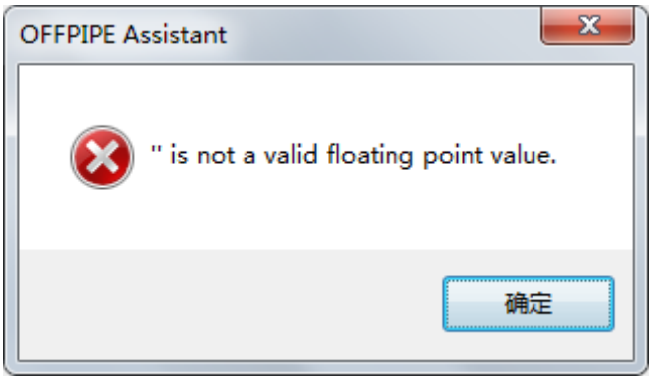


Fig. 5.1 Fault message window

How to solve: Make sure to fill all the blank comboboxes and edits before clicking “Calculate” button.

2. Software can not be started or run.

How to solve: Please insert the attached hard lock into one of USB port in your PC.

3. Please note that the local FEA core of OFFPIPE Assistant™ only provides finite element analysis with linear constitutive model. Nonlinear model is valid only when OFFPIPE calculation core is specified.

5 TECHNICAL SUPPORT & AUTHORIZATION

For technical support and authorization of OFFPIPE Assistant™, please visit:

http://www.offpipeassistant.com

or contact:

support@offpipeassistant.com